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Sand Beach and Coastal Lagoon Monitoring
Santa Rosa Island
1995 Annual Report

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ABSTRACT

Approximately 20 percent of the shoreline of the California Channel Islands is sandy beach. This contrasts with about 80 percent of the southern California mainland coast being sand beach. Though often overlooked, sandy beach communities may harbor high densities of organisms hidden within the interstices of the sand grains. These organisms play a vital role in the food web of shorebirds and fish.

Sand Beach monitoring was implemented on Santa Rosa Island in 1994 following the design protocol established by Dugan *et al*. (1993). This adds an integral part of the marine ecosystem to the long-term monitoring program at Channel Islands National Park. Various sampling methods were employed at eight beaches to describe the biological characteristics of the beach. These methods included bird censuses, physical measurements, clam gun (core) transects of both the upper beach and washzone, and point contact transects to measure macrophyte wrack on the beach. Pismo clams (*Tivela stultorum*) were sampled in both the intertidal and subtidal at Southeast Anchorage. Salinity, temperature, and depth measurements were made in three coastal lagoons.

Beach sampling was performed in late August 1995. Temperature recorders were in place from April 1995 to August 1996 in the Old Ranch House Canyon Lagoon. Pismo clams were sampled in November 1995.

The mouth of Old Ranch House Canyon Lagoon was frequently closed. Overwash occurred during the highest tides. Ranges of up to 10°C for single days were commonly observed, inferring fluctuating water depths and impacts through solar radiation. Dramatic downward shifts in the water temperature correspond to extreme high tides and probable overwash. Salinity ranged from 18 ppt. to 30 ppt. Bird diversity was highest at the Old Ranch House Canyon Lagoon. In May, a female mallard duck with seven ducklings were observed. This is the first recorded mallard nesting at the island.

Macrophyte wrack, mostly kelp (*Macrocystis pyrifera*) and surfgrass (*Phyllospadix* spp.), was most abundant on Sandy Point and Soledad West beaches and consequently invertebrates reached their highest diversity and abundance there. Beachhoppers (amphipods) were dense and quite large at Soledad Beach West ,numbering nearly 25,000 per meter of beach. Isopods, fly pupae, and predatory beetles were also common.

Sand crab (*Emerita analoga*) populations varied in composition and abundance. Sandy Point had the greatest densities, reaching nearly 12,000 per meter of beach.

Olive snails (*Olivella biplicata*) were quite common in the protected waters at Southeast Anchorage. The densities found, nearly 13,000 per meter, were much higher than to those found by Dugan *et al*. (1993).

A total of 73 pismo clams were captured for mark-recapture population estimates. Based on the recapture of 4 clams from 1994, a population estimate (using the Petersen single mark recapture formula) of 1,925 clams was made. This equals about 75% of the population estimates made during the design study. Density estimates of clams; however, were within the ranges found during the design study. Four clams from the 1989 transplant were recaptured and had grown from 40 to 91 mm, 55 to 102 mm, 57 to 98 mm, and 57 to 109 mm. A 1991 recapture had grown from 56 to 100 mm.

A beached decaying Minke Whale (*Balaenoptera acutorostrata*), reported by the island ranger, was measured on the east end of Southeast Anchorage. Measurements of a bottlenose dolphin (*Tursiops truncatus*) carcass were taken on the beach at China Camp.

INTRODUCTION

Sand beaches are a major component of the intertidal region of the northern Channel Islands. On Santa Rosa Island, sand beaches make up approximately 30 km of shoreline with a wide variety of exposures and beach types.

A design study for sand beach monitoring on Santa Rosa Island was completed in 1990 (Dugan *et al*. 1990). A draft report summarizing the inventory and design study was completed in February 1993 (Dugan *et al*. 1993). In 1994, the first efforts to implement the monitoring protocol were undertaken, adding this important component to the long-term monitoring efforts at Channel Islands National Park (Richards, 1996). The design of the sand beach monitoring provides a look at the intertidal fauna of the beaches and coastal lagoons of Santa Rosa Island. Physical characteristics of both beaches and lagoons were also measured. This report presents the data collected in 1995.

METHODS

Study Area

The California Channel Islands comprise eight islands located at various distances from the Southern California mainland, of which five are included in Channel Islands National Park. Santa Rosa Island (21,854 ha) has the most extensive beaches of the park Islands.

A variety of beach exposures are found on Santa Rosa Island ranging from low to high wave energy. Both temporal (storm activity) and geographic (exposure) differences influence the physical properties of beaches including slope, grain size, permeability, cusping, and stability. The physical properties in turn affect the beach fauna. Sampling sites were established by Dugan *et al* (1990) to represent the range of exposures and beach types found on Santa Rosa Island (Figure 1).

Sand Beach and Lagoon Monitoring Methods

Sampling techniques used are outlined in a monitoring handbook for sand beaches and coastal lagoons (Dugan *et al*. 1990). Lagoon temperatures were read at the various stations with handheld thermometers held just below the surface and at 10 cm depth. A HOBOTEMP^{tm} temperature logger was placed near the stage height recorder at station 4 at Old Ranch House Canyon Lagoon in April. Temperature readings were taken by the unit every 96 minutes. The logger was replaced on August 30, 1995 with another unit set to record every 4 hours, 48 minutes. Recordings ended August 24, 1996 when the memory was full. The loggers were attached to a concrete block, placed such that the unit would be suspended approximately 10 cm from the bottom. Sampling dates are listed in Table 1.

Standard beach sampling was conducted during August 1995 at four of the nine beaches recommended for monitoring in the handbook. Standard beach sampling included: four upper beach clam gun transects to estimate the abundance of beachhoppers, *Megalorchestia spp.*, and associated species; five wash zone clam gun transects to estimate abundance of sand crabs and isopods including *Emerita analoga*, *Excirolana chiltoni* and associated species; three point contact transects for percent cover and composition of macrophyte wrack; size frequencies of sand crabs; physical measurements; bird census. Sea temperatures were taken by wading into the surf and reading a thermometer held at 10 cm depth. Beach slope was measured using a level and ruler to measure the rise of the slope. The slope was calculated as the arctangent of the rise over the run multiplied by the conversion factor for expression in degrees. Data were managed in Microsoft Excel.

Pismo clams, *Tivela stultorum*, were monitored in November 1995 during annual intertidal monitoring by counting siphons in 100 m band transects. The band transects were conducted by two snorkelers swimming 2 m apart, perpendicular to shore, counting siphons within parallel 1 m wide swaths. Three sets of transects were conducted on 7 November. Intertidal populations were surveyed in 25 cm wide trench transects dug perpendicular to shore during low tide. Abundance, size frequency, and reproductive conditions for spiny sand crabs, *Blepharipoda occidentalis,* were also collected during the trench transects. Ten transects, 22 m in length, were dug on 5 November. Additional clams were collected during snorkeling searches to supplement size frequency distributions. All collected clams were marked with a double groove on the lower left valve (Figure 2) and returned to their respective zones. Olive shells, *Olivella biplicata*, were sampled in subtidal clam gun transects at Southeast Anchorage.

RESULTS

Physical Measurements

Lagoon measurements were taken on the 30th of August. Temperature and salinity data are presented in Table 1. Oat Point Lagoon was dry so no measurements were taken there. Old Ranch House Canyon Lagoon was closed at the mouth and was fairly full. Old Ranch Canyon Creek was flowing to the sea. A small backwater lagoon was developing after being washed out last spring and sea water from overwash was pooling in the lower strata.

Lagoon temperatures were logged every 96 minutes between April and August 1995 and every 4:48 between August 1995 and August 1996. Because the unit was attached to a concrete block on the bottom, the depth over time was variable as the water level changed.

Temperature data are presented in Figures 3a and 3b. The dramatic drops in temperature (most noticeable 7/10/95, 8/12/95) generally correlate well with extreme high tides and probably indicate overwash by the tide. The highest temperatures were recorded in June, the coldest in January. Daily temperatures fluctuated 10°C with the highest temperatures occurring in mid-afternoon and lowest around sunrise.

Slightly less dramatic temperature fluctuations appeared during the 1995 sampling season than in 1994. Increased water levels are likely the reason for the reduced daily temperature variations. Station 4 at Old Ranch House Canyon lagoon measured 87 cm depth in August. Increased water levels help buffer warming due to solar radiation.

Ruppia maritima and *Trichocorixa reticulata* were present in two lagoons in April. Fish fry were present at all Old Ranch House Canyon Lagoon stations in April and at three stations in August.

Ocean temperatures recorded during this study only ranged from 16°C to 18.5°C with the coldest temperature occurring at China Camp during high wind conditions (Table 1). Salinity was quite stable with all readings at 33 or 34 ppt. The calculated beach slope ranged from 29° to 46°. Physical parameters for the beaches are presented in Table 2.

Bird Census

Bird census data are presented in Table 3. No birds were recorded on the beaches at Sandy Point or Southeast Anchorage during the August census. A wandering tattler was seen at Southeast Anchorage during the November sampling The highest diversity of birds was found at Old Ranch House Canyon Lagoon. A mallard hen and seven ducklings were observed there on May 26, 1995. Three adult mallards were observed in July and six in November.

At China Camp, the conditions during sampling were high winds and blowing sand. Thirty four snowy plovers were counted at the west end of the beach, hiding behind the dune.

Tivela stultorum Pismo Clams

Tivela stultorum were sampled at Southeast Anchorage in the intertidal on 5 November on an incoming tide from a low of -0.1 ft. Ten intertidal transects were dug in the area of the third cove. The transects yielded 17 clams ranging in size from 19 mm to 147 mm (Table 4, Figure 4). All transects were approximately 22 m in length. A total of 54.75 square meters of beach were excavated yielding a clam density of 0.26 per square meter of beach, identical to the density found in 1994. Two clams from the transects were previously marked. One as a 1989 intertidal transplant that grew from 55 mm to 102 mm. The other, marked in 1991, had grown from 56 mm to 100 mm.

Tivela stultorum were sampled subtidally on 3 November on a outgoing tide to a low of -0.3 ft. Two snorkelers, searching for a total of 5.0 hours, collected 56 clams at a water depth of 1-3 m (Table 5). Subtidal transects covering a total of 2,400 square meters offshore from the third beach area, yielded 79 clams or 0.033 clams/m^2 (Table 5). Four clams displaying 1994 markings were captured. Three marked transplants were also captured, one intertidal and two subtidal transplants from 1989. Unmarked clams from the intertidal and subtidal were marked with two grooves on the lower left valve (LL2) (Figure 2) and returned to their respective habitat. The sizes of subtidal clams ranged from 91 mm to 159 mm (Table 5). Due to the fact that pismo clams were only sampled once in 1995, we used marked clams from 1994 and assumed a stable population to calculate a population estimate. Using the Peterson mark recapture formula a population estimate of 1,925 clams was obtained.

Because the transplanted clams had marks cut into the shell margin we can approximate the growth of those clams since October 1989. One of the 1989 transplants had a beautiful series of six dark bands since the transplant, strengthening our view that the heavy bands are annual rings. That particular clam was 40 mm when transplanted and had grown to 91 mm in six years. The two others were about 57 mm when transplanted and had grown to 98 mm and 109 mm.

Olivella biplicata were observed on all the subtidal transects. Other organisms observed during the transects were *Blepharipoda occidentalis, Cancer gracilis,* and *Dendraster sp.*

Olivella biplicata Purple olive snails

Five low intertidal clam gun transects were made on the first beach at Southeast Anchorage with a total of 136 cores over 122 m. A total of 561 snails were collected giving an average of 12,974 snails per meter of beach. Shell length ranged from 8 mm to 25 mm (Table 7, Figure 5). Other organisms observed within the transects included *Emerita, Blepharipoda,* polychaetes, *Alloniscus perconvexus*, juv. *Cancer* sp., *Lepidopa californica*, juv. *Panulirus interruptus*, *Pagurus* sp., *Crangon* sp., and a cumacean (Table 7).

Blepharipoda occidentalis Spiny sand crab

Intertidal *Blepharipoda occidentalis* were collected in trench transects on 5 November at Southeast Anchorage. A total of 390 crabs were collected, including heads, in 5 transects yielding an average of 14.36/m of beach(Table 8). Sizes ranged from 29-57 mm for males, 33-51 mm for ovigerous females, and 32-51 mm for non-ovigerous females (Figure 6).

Macrophyte Wrack

Macrophyte wrack data are presented in Table 9, and summarized in Table 9b. Transects were not conducted at Southeast Anchorage due to lack of beach wrack. Beach wrack coverage was highest at Soledad West with 37% surfgrass, 12% Macrocystis, and 4% other brown algae (53.4% total). While Soledad had more wrack than last year, Sandy Point had less. Sandy Point had the most terrestrial debris. Relatively little wrack was found at China Camp and Abalone Rocks, mostly small dried pieces of *Phyllospadix sp.* and fragments of *Macrocystis pyrifera*.

Upper-beach Transects

Results of the upper-beach clam gun transects are shown in Table 10 and are summarized in Table 13. Transect widths varied according to the beach characteristics. Abalone Rocks had the narrowest upper-beach area (14 m) and waves washed into the dunes at high tide. Soledad West (35 m) and Sandy Point (26 m) had the longest upper beach transects. At Sandy Point the high tide reaches the cliff. Small dunes and vegetation back the beach at Soledad West. *Megalorchestia* spp. were found in highest abundance on Sandy Point followed by Soledad West. China Camp and Abalone Rocks had extremely low numbers of beachhoppers relative to the other beaches.

Isopods, *Alloniscus perconvexus* were present in low to moderate abundances on all beaches except Abalone Rocks. Staphylinid beetles were found on all beaches. Fly pupae were common on Soledad West and noticeably present at Sandy Point. *Excirolana chiltoni* were present in upper beach transects at all beaches except Soledad West, and were most abundant at Abalone Rocks.

Wash-zone Transects

Wash-zone transect data are presented in Table 11 and summarized in Table 13. *Emerita analoga* densities in the transects ranged from 3,369 per meter at China Camp to 11,915 per meter of beach at Sandy Point. *E. analoga* megalopa were found in moderate numbers at Sandy Point and Soledad West. China Camp and Abalone Rocks displayed very low densities. Ovigerous crab densities were proportionately the same at all beaches, except Abalone Rocks, where only two crabs were found. *Excirolana chiltoni* were found at all four beaches in densities from 408/m to nearly 7,000/m of beach. *Euzonus mucronata* was common only at China Camp but present at Soledad West. *Nephtys californiensis* was common only at Abalone Rocks.

Supplemental sampling for sand crab size frequencies was performed at China Camp and Abalone Rocks where crab numbers were too low for adequate size frequencies. Non-ovigerous females made up the majority of the samples at all the beaches (Table 12). Sandy Point had the most ovigerous crabs (40%) (Table 14). China Camp had the largest number of small crabs and megalopa. The largest crabs were found at Abalone Rocks. The smallest ovigerous crabs were found at Soledad West in sieve #20 (corresponding carapace length 11.8 mm). Reproductive characteristics are summarized in Table 14. Population size frequencies for *Emerita* are displayed in Figure 7.

General observations

Two marine mammal carcasses were encountered during sampling. A Minke whale (*Balaenoptera acutorostrata*) in an advanced state of decomposition was observed near the south end of Southeast Anchorage beach. Measurements and photographs were taken as well as physical observations of the animal. The whale was 14 ft. long and positioned on its left ventral side. Ventral grooves were present on the throat and the dorsal fin appeared to be missing, likely due to decomposition or scavengers. No knuckles down the tail could be seen. At China Camp a large bottlenose dolphin (*Tursiops trunctus*) carcass was observed and found to be in a moderate state of decomposition. Measurements, photographs, and physical observations were taken. No obvious cause of death apparent. All marine mammal data was sent to Dr. Charles Woodhouse at the Santa Barbara Museum of Natural History.

DISCUSSION

General characteristics for Santa Rosa Island beaches are listed in Dugan *et al*. 1993. No major changes were noted in 1995.

Temperature loggers worked well. The logger seemed to be deep enough not to float during low water levels. However, the greatest daily temperature fluctuations coincided with a time at which the lagoon was flowing out to sea and the temperature unit was subject to solar radiation. The greatest daily temperature change was from 13°C at 0732 to 23.6°C at 1444 on April 11th .

The lowest temperature throughout the sampling period (8.4°C) occurred January 23, 1996, and the highest (26°C) on June 26, 1995.

Both readings occurred during the extremes of spring tides. During spring tides, waves wash over the beach berm, flooding the lagoon. This usually causes an outlet to form and the lagoon may empty during the low tide. This influx of water and fluctuating level can greatly affect temperature. Changes in the temperature regime also occurred in mid-June and early August, during periods of neap tides.

Old Ranch Canyon Lagoon was mostly backed-up fresh creek water, occasionally mixed with overwash from spring tides. The mouth was usually open to the ocean with some flow out.

During the dry part of the year, Oat Point Lagoon is entirely saltwater from tide overwash, becoming hypersaline as the water evaporates. Measurements were not taken during the winter rainy season when Oat Point is probably mostly fresh or brackish when combined with flood tides. Much of the year; however, this small lagoon is dry. Because of the unique hydrology, this lagoon and other transient ponds on the island, and the aquatic life they harbor, deserve more study.

Most organisms remained within the density ranges reported by Dugan *et al*. (1993). Sandy Point and Soledad West had the largest amounts of wrack on the beach and consequently had the highest diversity and density of both upper- and lower beach invertebrates (Table 13). Exciro*lana* was the only invertebrate common on both upper-beach and wash-zone transects, with the exception of Soledad West where they only occurred in the wash-zone. Beachhopper amphipods were quite dense on Sandy Point reaching 25,015 per meter of beach. Interestingly though, *Excirolana chiltoni* were found in moderate numbers at China Camp where there was little wrack and beachhopper numbers were extremely low. The morphology and exposure of this beach is likely responsible for the amount of debris trapped on the beach.

Sandy Point had high numbers of *Emerita*, beachhoppers, and *Excirolana*. Soledad West also had high numbers of *Emerita*, but lower numbers of beachhoppers and *no Excirolana.* The higher numbers of Staphylinid beetles may play a role in the lower numbers of beachhoppers and absence of *Excirolana* observed.

Olivella biplicata aggregate in protected subtidal sand flats and exhibit patchy distribution. The density of nearly 13,000/m is considerably higher than densities found in transects by Dugan *et al.* (1993). It is also almost 50% greater than densities recorded in 1994 (Richards 1996). The mean density of 562 snails/m^2 is over twice that found during the design study (226/m^2), but is less than the estimated 6,780 snails/m^2 from subtidal sampling (Dugan *et al.* 1993).

Size structure and composition of *Emerita analoga* populations were quite different on different beaches. Highest densities of sand crabs were found on Sandy Point (nearly 12,000/m). This was approximately one third the number found the previous year at the same location. Abalone Rocks had the lowest density of sand crabs (3,400/m). Sandy Point and Soledad West had the highest percentage of ovigerous females (Tables 12a,b).

A total of 73 *Tivela stultorum* were captured during the two types of sampling in November. Two clams from the intertidal and seven subtidal clams were recaptures from previous years. Four were transplants from 1989, four were marked in 1994, and one was marked in 1991. The transplanted clams had all grown at similar rates, nearly doubling in shell width.

Using the 1994 and 1995 captures for the Petersen single mark recapture formula, we estimate the *Tivela stultorum* population at 1,925 clams. This population estimate is only 75% of the 1990 estimates (Dugan *et al*. 1993), but much higher than our 1994 estimate of only 619. Pismo clams were sampled only once during 1995, thus the need to use 1994 data to calculate mark recapture population estimates. Densities estimated in 1995 were very similar to those found in 1994 and fell within ranges found during 1989-1990 (Dugan *et al*. 1993).

In 1995, a two strand electric fence was erected to protect snowy plovers from cattle trampling along nesting beaches at Skunk Point. The fence ran from Southeast Anchorage to the south side of the Old Ranch House Canyon Lagoon next to Abalone Rocks. The fence placement along the southeast shore was about 100 m inshore from the beach. It passed along the edge of the Oat Point pool, across the Old Ranch Canyon Creek just upstream from the lagoon, and around the Old Ranch House Canyon Lagoon. During 1995, cattle were observed on several occasions inside the fence in the lagoon area (personal observation and pers. comm. with island staff). The electric strands were removed in October after the breeding season. In 1996, the strands were in place from March through September. Effects of the fence building, and cattle enclosure on the lagoon environment are unknown.

RECOMMENDATIONS

The recommendations and concerns expressed in the 1994 annual report still apply. Because of a static budget, monitoring continued at the same level, with only half the beach sites being monitored. The Coastal Commission Nearshore Project did conduct “one-time” surveys on Santa Cruz Island beaches in 1995 and San Miguel Island beaches in September 1996. Site characterizations and species inventories were made to establish some baseline information (J. Engle, pers. com.). That project in cooperation with the National Park Service continued surveys of eelgrass beds and nearshore subtidal sandy areas at Santa Cruz, Anacapa, and Santa Rosa (Johnson’s Lee area) in 1995, and San Miguel in 1996.

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Table 11. Washzone clam gun transects

***Emerita anologa* abundance**

location	date	box size/spp	transect 1	transect 2	transect 3	transect 4	transect 5	Total/ Avg.	Std. Dev.
			Sandy Point						
		Emerita anologa abundance							
SRISP#1	31-Aug-95	transect length (m)	9.3	9.7	8.9	9.8	8.7	46.4	
		# cores	12	12	12	12	12	60	
		#38 total	2	4	3	3	1	13	
		#38 ovig	2	4	3	3	1	13	
		#28 total	7	13	14	9	9	52	
		#28 ovig	7	12	13	8	9	49	
		#18 total	8	43	26	14	17	108	
		#18 ovig	0	3	3	1	0	7	
		#8 total	65	103	67	39	93	367	
		#8 ovig	0	0	0	0	0	0	
		#4 total	4	3	18	7	36	68	
		#megalopa	0	2	6	0	11	19	
		#megalopa/m	**0**	**205.94**	**566.88**	**0**	**1015.92**	357.75	434.72
		# ovig crab	9	19	19	12	10	13.80	4.87
		# ovig crab/m	**888.54**	**1956.48**	**1795.12**	**1248.41**	**923.57**	1362.42	492.52
		# nonovig	77	147	109	60	146	107.80	39.47
		# nonovig/m	**7601.91**	**15136.94**	**10298.30**	**6242.04**	**13484.08**	10552.65	3773.66
		total crabs	***86***	***166***	***128***	***72***	***156***	121.60	41.60
		crabs+ megalopa	86	168	134	72	167	125.40	44.79
		core interval	0.78	0.81	0.74	0.82	0.73	0.77	0.04
		crabs/m	**8490.45**	**17093.42**	**12093.42**	**7490.45**	**14407.64**	11915.07	4011.40
		Excirolana	130	58	46	47	74	71.00	34.86
		Excirolana/m	**12834.39**	**5972.40**	**4346.07**	**4889.60**	**6834.39**	6975.37	3413.86
		Olivella	0	0	0	0	0	0	
		Euzonus	0	0	0	0	0	0	
		Euzonus/m	**0**	**0**	**0**	**0**	**0**	0	
		Nephtys	0	0	0	0	0	0	
		Nephtys/m	**0**	**0**	**0**	**0**	**0**	0	
		Blepharipoda	0	0	0	0	0	0	
		Lepidopa	0	0	0	0	0	0	

Table 11. Washzone clam gun transects

location	date	box size/spp	China Camp transect 1	transect 2	transect 3	transect 4	transect 5	Total/ Avg.	Std. Dev.
		Emerita anologa abundance							
SRICC#3	31-Aug-95	transect length (m)	12.5	10.8	10.7	10.3	11.2	55.5	
		# cores	25	25	25	25	25	125	
		#38 total	0	0	1	0	0	1	
		#38 ovig	0	0	1	0	0	1	
		#28 total	0	0	5	5	3	13	
		#28 ovig	0	0	4	4	2	10	
		#18 total	2	0	7	88	2	99	
		#18 ovig	0	0	0	0	0	0	
		#8 total	15	5	41	6	25	92	
		#8 ovig	0	0	0	3	0	3	
		#4 total	0	7	39	28	29	103	
		#megalopa	1	2	25	18	21	67	
		#megalopa/m	**63.69**	**110.06**	**1363.06**	**944.71**	**1198.47**	736.00	611.24
		# ovig crab	0	0	5	7	2	2.80	3.11
		# ovig crab/m	**0**	**0**	**272.61**	**367.39**	**114.14**	150.83	164.75
		# nonovig	17	12	88	120	57	58.80	46.20
		# nonovig/m	**1082.80**	**660.38**	**4797.96**	**6298.09**	**3252.99**	3218.45	2402.34
		total crabs	***17***	***12***	***93***	***127***	***59***	61.60	49.29
		crabs+ megalopa	18	14	118	145	80	75.00	58.62
		core interval	0.50	0.43	0.43	0.41	0.45	0.44	0.03
		crabs/m	**1082.80**	**660.38**	**5070.57**	**6665.48**	**3367.13**	3369.27	2565.42
		Excirolana	1	3	11	19	10	8.80	7.16
		Excirolana/m	**63.69**	**165.10**	**599.75**	**997.20**	**570.70**	479.29	375.01
		Olivella	0	0	0	0	0		
		Euzonus	0	1	0	62	8	14.20	26.93
		Euzonus/m	**0**	**55.03**	**0**	**3254.01**	**456.56**	753.12	1411.04
		Nephtys	0	0	0	0	0		
		Nephtys/m	**0**	**0**	**0**	**0**	**0**		
		Blepharipoda	0	0	0	0	0		
		Lepidopa	0	0	0	0	0		

Table 11. Washzone clam gun transects

location	date	box size/spp	transect 1	transect 2	transect 3	transect 4	transect 5	Total/ Avg.	Std. Dev.
			Abalone Rocks						
		Emerita anologa abundance							
SRIAR#5	30-Aug-95	transect length (m)	16	14.9	13.2	16.1	16.1	76.3	
		# cores	20	20	20	20	20	100	
		#38 total	0	1	0	1	2	4	
		#38 ovig	0	1	0	0	1	2	
		#28 total	0	0	0	1	1	2	
		#28 ovig	0	0	0	0	0	0	
		#18 total	11	6	4	3	9	33	
		#18 ovig	0	0	0	0	0	0	
		#8 total	50	43	28	17	24	162	
		#8 ovig	0	0	0	0	0	0	
		#4 total	1	25	5	9	0	40	
		#megalopa	1	5	1	3	1	11	
		#megalopa/m	**101.91**	**474.52**	**84.08**	**307.64**	**102.55**	214.14	172.12
		# ovig crab	0	1	0	0	1	0.40	0.55
		# ovig crab/m	**0**	**94.90**	**0**	**0**	**102.55**	39.49	54.14
		# nonovig	62	74	37	31	35	47.80	19.04
		# nonovig/m	**6318.47**	**7022.93**	**3110.83**	**3178.98**	**3589.17**	4644.08	1875.68
		total crabs	***62***	***75***	***37***	***31***	***36***	48.20	19.23
		crabs+ megalopa	63	80	38	34	37	50.40	20.23
		core interval	0.8	0.745	0.66	0.81	0.81	0.76	0.06
		crabs/m	**6318.47**	**7117.83**	**3110.83**	**3178.98**	**3691.72**	4683.57	1892.06
		Excirolana	2	1	0	16	1	4.00	6.75
		Excirolana/m	**203.82**	**94.90**	**0**	**1640.76**	**102.55**	408.41	692.67
		Olivella	0	0	0	0	0		
		Euzonus	0	0	0	0	0		
		Nephtys	0	1	0	2	1	0.80	0.84
		Nephtys/m	**0**	**94.90**	**0**	**205.10**	**102.55**	80.51	85.41
		Blepharipoda	0	0	0	0	0		
		Lepidopa	0	0	0	0	0		

Table 11. Washzone clam gun transects

location	date	box size/spp	transect 1	transect 2	transect 3	transect 4	transect 5	Total/ Avg.	Std. Dev.
			Soledad West						
		Emerita anologa abundance							
SRISW#9	30-Aug-95	transect length (m)	17.3	15.5	18.4	16.1	13.7	81	
		# cores	20	20	20	20	20	100	
		#38 total	0	0	0	0	0	0	
		#38 ovig	0	0	1	0	0	1	
		#28 total	2	9	8	12	8	39	
		#28 ovig	2	8	8	11	8	37	
		#18 total	8	15	15	9	17	64	
		#18 ovig	3	5	10	3	2	23	
		#8 total	56	97	52	84	73	362	
		#8 ovig	0	0	0	0	0	0	
		#4 total	5	9	9	15	14	52	
		#megalopa	0	5	1	5	3	14	
		#megalopa/m	**0**	**493.63**	**117.20**	**512.74**	**261.78**	277.07	226.38
		# ovig crab	5	13	19	14	10	12.20	5.17
		# ovig crab/m	**550.96**	**1283.44**	**2226.75**	**1435.67**	**872.61**	1273.89	635.98
		# nonovig	66	117	65	106	102	91.20	24.10
		# nonovig/m	**7272.61**	**11550.96**	**7617.83**	**10870.06**	**8900.64**	9242.42	1911.47
		total crabs	***71***	***130***	***84***	***120***	***112***	103.40	24.92
		crabs+ megalopa	71	135	85	125	115	106.20	27.15
		core interval	0.87	0.78	0.92	0.81	0.69	0.81	0.09
		crabs/m	**7823.57**	**12834.39**	**9844.59**	**12305.73**	**9773.25**	10516.31	2051.21
		Excirolana	1	15	23	20	12	14.20	8.53
		Excirolana/m	**110.19**	**1480.89**	**2695.54**	**2050.96**	**1047.13**	1476.94	983.26
		Olivella	0	0	0	0	0		
		Euzonus	53	55	33	49	16	41.20	16.53
		Nephtys	0	0	0	0	0		
		Nephtys/m	**0**	**0**	**0**	**0**	**0**		
		Blepharipoda	0	0	0	0	0		
		other polychaete	0	0	0	0	0		